tered references to studies of social behavior and these relate to bees, fish, and birds. Neither author claims to provide a compendium for the animal behavior field. Rather each ranges selectively across a broad and diverse literature. Teachers should find good use for these as textbooks or as supplementary reading, depending upon the background of the student. They are intermediate in difficulty, each one presupposing as a minimum some introductory work in zoology, physiology, and psychology.

The seriously interested student will find himself impelled to go to original sources. Space did not permit these writers to present full details of many, or even of the majority, of the studies that supply the basis for their principles of animal behavior.

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Regulatory Biology

Control Theory and Biological Systems. Fred S. Grodins. Columbia University Press, New York, 1963. xii + 205 pp. Illus. $8.50.

Regulatory and adaptive processes have long been central subjects in biology. The principle of homeostasis, detailed knowledge about several control mechanisms, and, to a limited extent, an understanding of the interactions and integration through which orderly and stable function is achieved in the whole organism are in hand. Although there are many significant questions that remain unanswered, the time is ripe for a synthesis—for the establishment of generalizations which may ultimately become biological laws—and for a formal treatment that facilitates understanding and suggests predictions which could be tested experimentally. It was, however, less the present state of physiological knowledge and more the recent, well-developed analytical treatment of control systems by engineers that led Grodins to write this book. Since the last war, "feedback control," "servoregulator," "transfer function," and other bits of engineering jargon have come to be used by the biologist almost as commonly as by the engineer, but more often than not the biologist is still unaware of the rigorous foundation, or the complex ramifications of modern control theory. Clearly it is important that he catch up with more than the words, for despite the fact that engineers treat the nonliving world, there are close analogies between their models and many systems in the living animal. And in abstraction, all the differences should disappear. Although the biologist may eventually have to go beyond the point where the engineer stops, it is important that he start at the beginning and assimilate the concepts and the formalisms of modern physical control theory.

In the first six chapters of this book, Grodins summarizes the salient features of systems behavior, drawing exclusively on physical examples. Some of the important mathematical techniques, including the Laplace transform, are introduced very simply, and the usefulness of analog computers is repeatedly emphasized. Concepts, both intuitive and rigorous, of transient and steady state response are clearly set forth, and the problem of stability is introduced. Such a compressed digest will leave many readers dangling, for the treatment is not complete in either scope or depth. Almost certainly it was not meant to be. This is an introduction for biologists—far from exhaustive, but not too gentle either. It is not a condescending survey. Selected references are provided for the reader who seeks more. With or without the extra reading, it is a safe prediction that any biologist who grasps these six chapters will have acquired new and deeper insights into general aspects of control, whether in living, or nonliving things.

The next two chapters examine two well-studied physiological control systems, the respiratory and the cardiovascular, from the standpoint of the principles and methodology set forth earlier. At this point most physiologists are likely to feel somewhat let down. These chapters are inconclusive, but perhaps for good reason. Not only do the problems immediately take form as nonlinear differential equations which lie outside the scope of the introductory principles, but also some of the elementary experimental data are still too incompletely understood. Nonetheless, the reader has been led to expect more than he gets when the theory of control is focused on these physiological problems. The final chapter is devoted to a summing up and a discussion of prospects for the future.

For the biologist in general, and the physiologist in particular, Grodins' book can be recommended as a clearly written introduction to control system theory. In contrast to other books on the subject, this one is written by a physiologist for the use of physiologists. It signals an important step in the development of regulatory biology.

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Permian System

Standard Wolfcampian Series (Permian), Glass Mountains, Texas. Charles A. Ross. Geological Society of America, New York, 1963. viii + 205 pp. Illus. $7.50.

Although the type section of the Permian System is in Russia, North American geologists generally look to the Permian sequence of the Trans-Pecos region in Texas as a continental standard of reference. In this book, Charles Ross describes the stratigraphy and paleontology of the standard American section for the Wolfcampian, the oldest Permian series.

Perhaps the principal contribution here is the definition of stratigraphic ranges, for different species of fusulinid Foraminifera, within a complex sequence of strata that cross the boundary between the Pennsylvanian and Permian systems. More than half the book is devoted to systematic descriptions of the fusulinids, 50 species of which are represented. The ample and quantitative descriptions are illustrated by 248 enlarged photographs that show the diagnostic internal structures of the shells. The stratigraphic horizons of the fusulinids were determined by reference to 43 detailed sections. These, in turn, form the basis for a restored section of the Upper Pennsylvanian and Lower Permian rocks along the southern front of the Glass Mountains.

The Wolfcampian emerges from Ross's reconstruction as a time-stratigraphic unit, physically represented by two mutually unconformable formations, each of which rests locally upon Pennsylvanian or older rocks, and the younger of which is overlain unconformabily by the Leonard Formation. Thus defined, the Wolfcampian has been taken to correspond essentially with the ranges of *Pseudoschwagerina* and *Paraschwagerina*. This has called